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ELECTRONIC BUSINESS

NOVEMBER

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES — WORLD

FEBRUARY 4, 1991

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NOVELL LEADS NETWORK GROWTH BATTLE

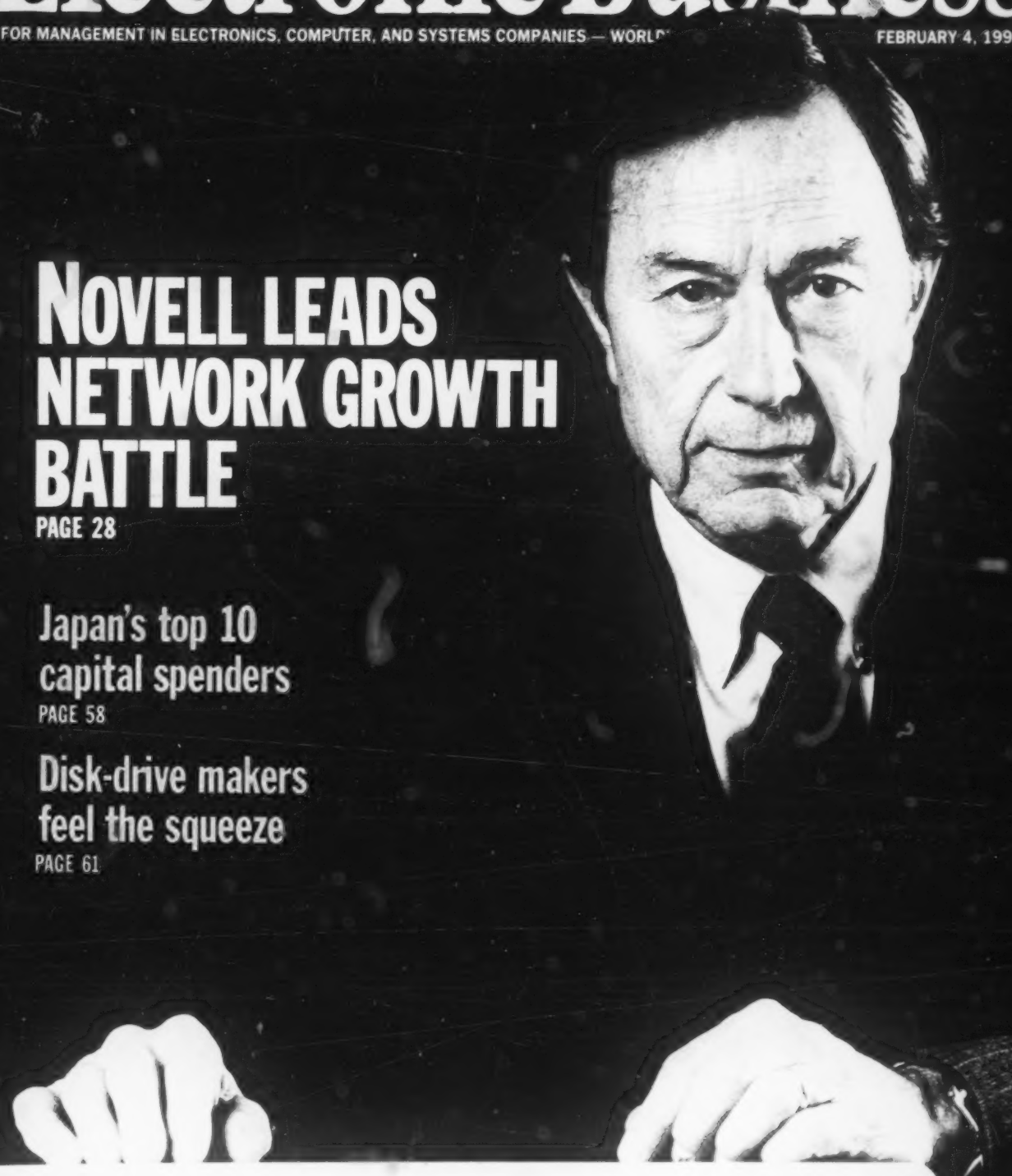
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Japan's top 10
capital spenders

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Disk-drive makers
feel the squeeze

PAGE 61



Novell Inc. president
and CEO Raymond J. Noorda

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 17, NO. 3

FEBRUARY 4, 1991



PAGE 28 Novell Inc.'s Raymond J. Noorda, regarded by some analysts as "one of the best managers in the industry"

COVER STORY/NOVELL

28 Novell sets its sights on corporate networking

Novell Inc. president, CEO, and chairman Ray Noorda's decision to focus his company's development efforts on LAN software has paid off. Versions of Novell's NetWare product line hold about 60% of the network operating system marketplace. Now Novell has embarked on a quest to connect every type of computer and network on the corporate scene

Cover: Paul Fraughton

UPDATE

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The war in the Persian Gulf is the first real test for the U.S. military's arsenal of high-tech weapons, and the conflict has implications for the defense electronics industry and the U.S. economy

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Zenith supports digital HDTV; workstation budgets shrink; Asian-Pacific telecom growing; Compaq serves an ace; outlook up for electronics growth; SII yields progress, protest; British Telecom, IBM talk deal; software pirates on the run; connector forecast cloudy

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Problem-solving software; video cameras on autopilot; versatile PCs

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A structural mismatch with its competitors may doom U.S. pure-play semiconductor manufacturing, but the U.S. computer industry can survive, says Weitek CEO Arthur J. Collmeyer

COVER STORY/NOVELL

28 Novell sets its sights on corporate networking

Novell built its networking business from the bottom up, targeting small business customers and departmental workgroups for most of the 1980s. Having set PC users free of their data processing departments, Novell is now in the somewhat ironic position of wooing corporate MIS executives. The reason: The thousands of PC LAN islands that have surfaced need to talk to one another, as well as to company mainframes and minicomputers

30 Microsoft puts on the pressure

The biggest challenge to Novell's networking hegemony comes from PC software giant Microsoft's LAN Manager. Microsoft plans to spend about \$60 million this year on personnel and marketing to boost sales of the network operating system

COVER STORY/NOVELL

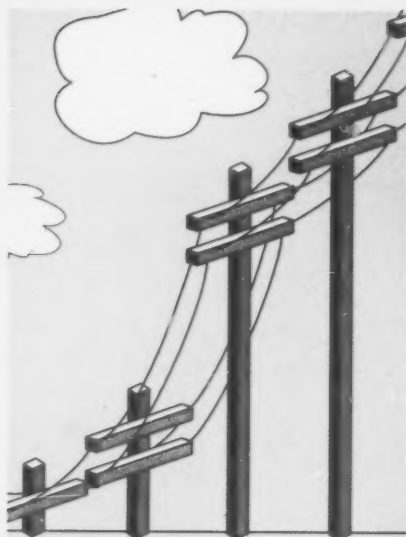
31 Aborted Lotus deal all but forgotten

What was to have been the biggest software deal of 1990 never made it off the ground. Citing unequal board representation, Novell's Ray Noorda axed a \$1 billion merger with Lotus Development Corp., leaving Lotus chairman Jim Manzi stunned and analysts amazed. Today, though, the bruised egos and recriminations are all but forgotten, Noorda says

STRATEGIES

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Acquisition by a Japanese conglomerate sounds like the kiss of death to some U.S. executives. But Garrett E. Pierce, president of Materials Research Corp., says life is very good indeed after Sony Corp. acquired the Orangeburg, N.Y.-based vendor of semiconductor production equipment and other thin-film technologies



PAGE 13 Asian nations are investing heavily in telecommunications

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PAGE 34 MRC will be among the big players in chip materials, says president Garrett Pierce



PAGE 42 Matthew Lorber, president and founder, and Dick Burwen, director of research, back together at Copley Controls



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Many electronics manufacturers hope to beat the recession at home by taking their products to Europe. While the weakened dollar does make their goods a bargain, the road to success can be a bumpy one. Here's how some small U.S. companies are faring

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Even in relatively healthy Czechoslovakia, Poland, and Hungary, U.S. companies are finding Eastern Europe is no bargain hunter's paradise, especially in electronics

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EDITORIAL STAFF

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Editor: Jeffrey Bairstow
Managing Editor: H. Garrett DeYoung
Senior Editors: Linda Stallmann (Financial), Rick Whiting, Barbara N. Berkman, Teri Sprackland
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Assistant Production Editor: Maura A. Baker
Editorial Assistant: Jean O'Brien

ART STAFF

Art Director: Michael Roach
Associate Art Director: Carla Aguiar Leeder
Staff Artist: Michele G. Kane

EDITORIAL OFFICES

Boston: Cahners Building
 275 Washington Street, Newton, MA 02158
 (617) 964-3030 Telex: 94 0573 CPC BSN
 Fax: (617) 558-4327 MCI: EBBOS
San Jose, Calif.: Teri Sprackland
 Sherman Building, 3031 Tisch Way, Suite 100,
 San Jose, CA 95128 (408) 243-8838
Northwest: Dwight B. Davis
 2924 Queen Anne Ave.,
 Seattle, WA 98109 (206) 44-5130
London: Barbara N. Berkman
 27 Paul Street
 London EC2A4JU England 011-44-71-628-7030
 Fax: 011-44-71-628-5984

PRODUCTION

VP Production: Wayne Hultzky
Director of Production/Manufacturing:
 John R. Sanders
Production Supervisor: Andrew A. Jantz
Production Manager: Betsy Harkins;
 (617) 964-3030

CIRCULATION

Circulation Manager: Ann Ward
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Japan by the numbers: cutting through the myth

Japan's success has assumed such mythic proportions that covering its companies, or competing with them, can be intimidating at the outset. But sometimes a little arithmetic helps put the problem in perspective.

Take capital spending. We're used to seeing yen poured like water into critical sectors of the Japanese electronics industry. But now, while capital spending booms in the rest of the Japanese economy, corporate reports show Japan's electronics companies are closing the tap; they too must adjust to the rising cost of capital and the slowing economy.

Where did we get this information? From contributing editor Paula Doe, our Seattle-based *sensei* on the finances of Japan's electronics industry. Her story on Japanese capital spending is one of many insightful reports Paula has filed.

Japanese manufacturing and market-research companies pour out a ton of helpful statistics every year. Unfortunately for U.S. executives, a relatively small portion of the data is published in English, and disclosure requirements are more relaxed in Japan. You have to know where to look and who to ask.

That doesn't stop Paula. After spending her high school years in Japan with her family, she undertook graduate studies in Japanese literature at the University of Wisconsin



Paula Doe: Getting the latest on Japanese electronics

and in 1980 wrote a book on the subject. Luckily for ELECTRONIC BUSINESS, Paula decided that Japanese high-tech business would be a more interesting field for her research and writing skills.

Certainly, understanding how Japanese business works is of critical interest to U.S. companies. CEO Arthur Collmeyer, in his commentary in this issue, explains how the shift to VLSI

technology has put pressure on the semiconductor industry to boost capital expenditures on wafer fabrication. That pressure, says Collmeyer, favors the vertically integrated Japanese computer company and virtually dooms the U.S. pure-play chip maker. But U.S. executives have learned a painful lesson or two, and many of them are taking steps to shield themselves.

Paula Doe agrees there have been positive changes. Americans' perceptions about Japan have become much more sophisticated, she says, and there's a much deeper understanding at all levels of management. Nevertheless, she warns, "there's still a tendency to be overconfident. We tend to think we won't have problems in software or large-computer systems."

Beware that overconfidence. Remember the Japanese proverb: "If you understand everything, you must be misinformed."

JOHN PARKER, section editor

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VBPA ABP

HDTV

Zenith lends credibility to dream of digital HDTV

WHEN THE Berlin Wall came down, you knew that democracy was likely to become a reality in Eastern Europe. That same kind of feeling—on a different scale—happened when Zenith and AT&T announced an all-digital HDTV system December 17.

Ever since New York-based General Instruments Corp. slipped a last-minute proposal before the Federal Communications Commission in June, there has been plenty of hype swirling around the possibility of a national, all-digital HDTV system. But while visions of vastly improved picture quality and computer-like televisions danced in industry-watchers' heads, the overriding mood regarding such systems was one of skepticism. How was it possible to compress data-intensive digital signals into the 6-megahertz bandwidth required by federal regulations? It wasn't clear that such compression could even be accomplished for the less-powerful 30-MHz analog signals proposed in analog-based systems.

Zenith's yuletide entry validates these hopes in a way previous proposals from General Instruments and a consortium of the David Sarnoff Research Laboratories, NBC, and the U.S. subsidiaries of Philips and Thomson could not. The Glenview, Ill.-based company has been widely considered the front-runner with its existing, semidigital Spectrum Compatible transmission system. It has been a voice of technological conservatism—even as competitors determined to cash in on the multi-billion-dollar promise of HDTV hurled claims and counterclaims. "Before it would not have been smart, economical, or demonstrable to stick their neck out by announcing a digital system," says analyst James I. Magid, a senior adviser with Needham & Co. "But now they really have something to show."

Technical reactions to the proposal have been positive. The system would offer higher resolution than competing proposals, and it meets FCC "simulcast" requirements to make the signals fit into the "fallow" channels that separate the ones on

your conventional television. The proposal came after technical breakthroughs by Zenith, which developed a digital filtering system that prevents cross-interference between existing NTSC channels and the proposed digital transmissions; by AT&T's Bell Labs, which developed a new video-compression algorithm; and by AT&T Microelectronics, which made the digital signal processors to execute that algorithm.

The system, which will replace the spectrum-compatible system previously proposed by Zenith, will be tested in October by the Advanced Television Testing Center in Alexandria, Va. The FCC plans to make a final decision in 1993.

PETER BURROWS

WORKSTATIONS

Workstation demand exceeds cash supply

WITH THE PRICES of workstations falling, this might seem like the time to stock up on these big-ticket computers. But users are bowing to economic pressure and cutting their

workstation spending, says Prudential-Bache Securities' latest survey of the U.S. workstation market.

The survey gathered 400 responses from users of equipment from Sun Microsystems, IBM, Hewlett-Packard, Digital Equipment, and other vendors. Here is what the responses indicated:

- As economic reality kicked in during 1990, buyers used price cuts to reduce their overall spending rather than to buy more workstations—an unusual trend in the computer industry. The result was a sharp drop in estimated spending. The pattern could well be repeated this year. While mailed responses indicated plans to increase workstation spending, a follow-up telephone survey showed two-thirds of the respondents expected flat or decreased spending in 1991;
- In addition to price/performance, users are looking hard at compatibility with their installed base of equipment. This helps Sun, still the market leader, but DEC and IBM appear to have gained user loyalties since the last survey;
- The support and delivery problems that bothered Sun users in the last survey are still bothering them, despite some improvements;
- Workstation buyers are making an effort to buy open operating systems, even if they still use mostly proprietary systems now;
- At least in the technical arena, workstations will increasingly be used to replace traditional mini-computers.

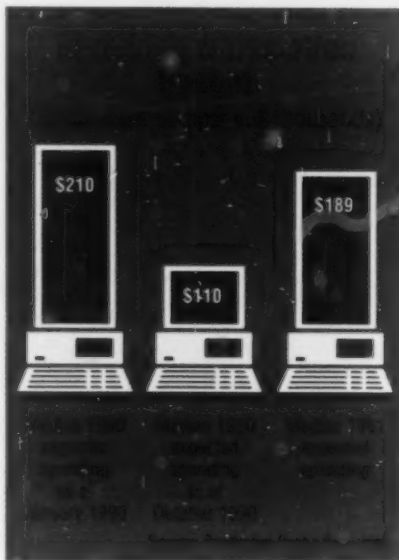
JOHN PARKER

ASIA

Asian-Pacific telecom ringing up growth

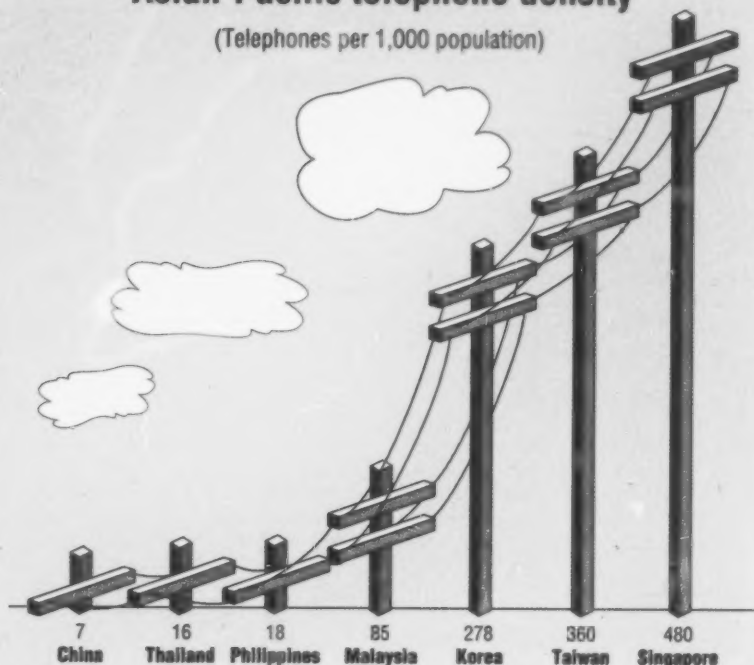
AS ASIAN-PACIFIC countries strive to catch up with advanced world standards, U.S. companies can expect to tap the region's growing demand for telecommunications equipment.

"The populous Asian-Pacific region cherishes lots of opportunities for the U.S. telecommunication equipment companies," says Wei An, an industrial analyst at CSP Associates, a consulting firm in Cambridge, Mass. The region is quickly becoming



Asian-Pacific telephone density

(Telephones per 1,000 population)



Source: Statistical Office of the United Nations & CSP Associates

the world's second-largest telephone network, trailing only the United States, says An. He estimates the region's investment in telecommunications will reach \$100 billion over the next five years.

Asian-Pacific telephone networks are expanding at an annual rate of 6.7%, leading Europe's 4.4% and North America's 2.8%. The region's share of the global telecommunications equipment market will rise to 31% by 1992, from 25% in 1988, according to recent figures.

Singapore may now possess the most advanced telecommunications systems in Asia after two decades of government-sponsored development. The telephone density of the country reached 480 per 1,000 residents by 1989, while the United States has 760 telephones for every 1,000 residents.

A major driving force behind the quick development of telecommunications networks in Asia is consistently strong government funding. As of 1989, the rate of Singapore's spending for information technology stood the highest in Asia—\$13.30 of each \$1,000 spent. In this tiny nation, the telecommunications system

is operated by Singapore Telecom, a government-owned monopoly. Over the past five years, Singapore Telecom has invested a total of \$1.7 billion for telecommunications development. It has also approved another \$2.1 billion through 1992.

The value of the telecommunications equipment market in Singapore alone, as An estimates it, will reach \$625 million by 1995 from \$427.7 million in 1990. Switching equipment, transmission equipment, and data communications are the three major areas of government spending.

To accommodate its fast economic development, the Taiwan government has invested about 1.05% of its gross national product to develop its public telecommunications network and services over the past decade. In 1989, Taiwan's telecommunications network growth ranked ninth in the world.

With its non-gold hard-currency reserve steady at about the \$70 billion level, the cash-rich island is spending aggressively on updating its telecommunications technology. In 1989, Hughes Network Systems Inc. won a \$7.4 million order from Taiwan's

Long Distance Telecommunications Administration to provide a data, voice, and video satellite communications network.

Meanwhile, Taiwan's National Science Council is now carrying on a five-year (1990 to 1995) satellite system development project, which will eventually enable Taiwan to build and launch a 440-pound satellite. The price tag of this project is \$364 million, or roughly 3.8% of Taiwan's GNP, a figure similar to Japan's spending on telecommunications. According to CSP's An, this project will be undertaken by subcontracting and technology transfer and will involve 67 research institutes and manufacturers in Taiwan and about a dozen foreign manufacturers, including TRW, Unisys, GE, and Motorola.

XIONG XIAOGE

MARKETING

Compaq hopes to serve an ace in Europe

THE BIGGEST prize paid in tennis history, \$2 million, went to U.S. Open champion Pete Sampras, compliments of Compaq Computer Corp. and the Compaq Grand Slam Cup Tournament.

Compaq spent millions to sponsor the Grand Slam Cup in an attempt to market the Compaq name in Europe. "At some time we needed to diversify beyond print. As we grew larger and more financially sound, TV made sense. We felt we needed to do more with brand awareness," explains Eckhard Pfeiffer, Munich-based president of Compaq Europe and International.

Compaq committed to a five-year contract to sponsor the first annual Grand Slam Cup Tournament. For its massive investment Pfeiffer says Compaq got "hundreds and hundreds of hours of transmission" into 85 countries, including the Eastern European market where Compaq will be making a special play.

One Compaq employee spent most of the six-day tournament in a control room pressing a little button that made Compaq's name flicker on the TV screen when the scores were broadcast.

Compaq developed a database for

the Grand Slam that included vital statistics on the game, points, profiles, and performance of the players, updated instantly. The press and tournament attendees had access to 100 desktops, laptop, and notebook personal computers supported by the Compaq SystemPro.

Some Grand Slam players also tapped into the database to check their performance stats between matches. Not Ivan Lendl, though. He was spotted playing the tennis simulation computer game Compaq also provided.

BARBARA BERKMAN in London

FORECASTS

The outlook is up for electronics growth

RECESSIONARY fears will take the edge off the next business expansion cycle, but the electronics industry still can look forward this year to 4.2% growth in shipments—a little better than last year's growth, according to Cahners Economics 1991 *Economic Outlook*.

Cahners's economists forecast 6.1% growth in new orders for electronic components, a 6.6% increase in semiconductor sales, and a 4.5% increase in shipments of computers. In the electronic instruments and controls sector, shipments are forecast to rise 3.9% above 1990 levels, with the automatic test equipment market recovering from two tough years to post a 6.1% sales increase.

Defense budget cuts will take their expected toll on military electronics sales, forecast to fall 1.3% this year. For consumer electronics, the Cahners outlook is for flat growth in sales of conventional equipment but an increase for technologically advanced equipment for home theater systems.

The 57-page 1991 *Economic Outlook* tracks trends in the financial and international markets and in more than 30 industrial and service sectors of the U.S. economy. Readers can obtain copies for \$11, the cost of shipping and handling. Write: Cahners Economics, 275 Washington St., Newton, MA 02158; or telephone (617) 964-3030.

JOHN PARKER

TRADE

SII's first fruits hard to swallow

SII PROGRESS REPORT: In its first response to last year's agreement on the Strategic Impediments Initiative, the Japan Fair Trade Commission has released for U.S. consumption its proposed guidelines for regulating unfair trade practices in sole-import distribution contracts. "The fact we have draft guidelines is terrific progress," says William Krist, vice president of international trade affairs for the American Electronics Association. "A year ago, they would have just put the guidelines into effect."

So much for the good news. The Washington-based AEA says the guidelines themselves are seriously flawed because the proposed regulations apply only to foreign companies seeking distributors to the Japanese market. In fact, the requirement that foreign companies—and only foreign companies—register sole-distributor agreements with the fair-trade commission as public documents gives Japanese companies an edge by forcing exporters to "tell the competition

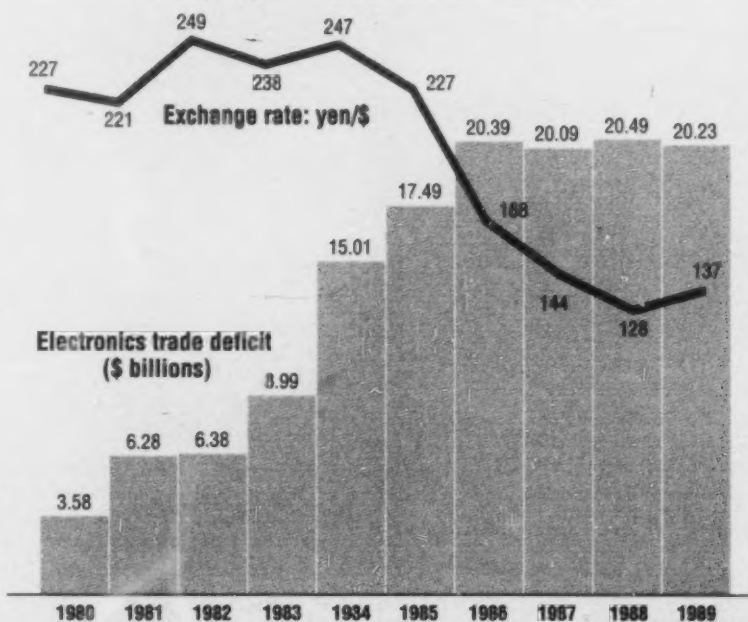
what you are doing," says Krist.

As part of their SII agenda, U.S. trade officials have been nudging Japan to strengthen its antitrust policy as a way of offsetting the intimidating power of the huge Japanese trading and manufacturing alliances. The registration of distribution agreements could help, but only if it applies to domestic as well as foreign companies, says trade consultant Orit Frankl in Washington. "We feel this is something that is going to further inhibit access to the Japanese market; it is not progress," she says.

Guidelines on other SII issues, including import clearance and patent pendency, are expected from Japan in the next few months. Meanwhile, the United States is seeing an improvement in its electronic balance of trade with Japan. The AEA estimates that the U.S.-Japan electronic trade deficit fell 10% in 1990, from \$20.2 billion in 1989 to \$18.2 billion, thanks largely to a surge in third-quarter exports by U.S. companies.

But the AEA warns the respite will be brief. Although recent weakening of the dollar makes U.S. exports attractive short-term, the industry group says that historically the trade deficit has expanded independently

U.S.-Japan trade: dollar vs. deficit



Source: American Electronics Association

of the yen-dollar exchange rate.

"Japanese companies have not increased their prices to align them with a stronger yen, particularly in areas, such as VCRs and integrated circuits, that are the subject of fierce global competition," says the AEA.

JOHN PARKER

TELECOM

British Telecom, IBM ponder alliance

U.K.-BASED British Telecommunications plc and IBM may informally collaborate to offer data-communications services to large multinational corporations.

For IBM, any alliance with BT would give improved access to BT's British customers. Neither IBM nor BT would discuss the plan, but it is understood that BT would manage

IBM's internal system and IBM would provide the software. The goal is to offer one-stop shopping for communications and computer services.

For BT, a link with IBM would wed Big Blue's massive internal communications system with BT Tynnet, the British company's international data network company.

Observers concluded that IBM's relocation of its communications division to London in January is closely linked with the discussion with BT. Publicly, IBM stated only that it is "constantly in contact" in discussions with a number of companies.

The cooperation would be an informal one, thereby skirting European antitrust regulations. In Britain, recent moves to deregulate the data-communications market pave the way for the IBM-BT talks. But elsewhere in Europe, state-owned public phone authorities won't be so quick to allow competition.

BARBARA BERKMAN in London

CONNECTORS

Aviation, automotive sales help out

THE U.S. connector industry is facing another slow-growth to no-growth year. For U.S. manufacturers, there are some bright spots overseas; as in the past, European and Asian markets are expected to exceed U.S. growth rates.

But even within the United States, the savvy marketer will note pockets of growth. Sales into the commercial aircraft and the automotive markets show healthier growth.

BARBARA JORGENSEN

The connector point-of-sale forecast

Market	1991 sales (\$ millions)	Change from 1990 (percentage)
Automotive	375.7	7.1
Electrical equipment	405.1	3.5
Electronic equipment	7,314.6	-0.2
Computer equipment	2,841.8	1.0
Telecom/datacom	1,169.0	4.0
Government/military	1,042.9	-8.4
Commercial aircraft	193.3	6.5
Industrial electronics	203.8	1.5
Test & measurement	422.4	0.0
Consumer electronics	106.9	1.5
Medical	155.1	4.3
Total:	\$ 8.1 billion	Average: 0.3%

Source: Fleck International Inc.

SOFTWARE

Using software to catch software pirates

ILLEGAL COPYING of software results in annual losses of about \$4 billion worldwide and \$1.5 billion in the United States. But the Washington, D.C.-based Software Publishers Association believes a combination of litigation, corporate auditing, and employee education is beginning to turn the tide on software piracy.

"There is a lot of parked software on hard disks that users don't even know is there," says SPA executive director Kenneth Wasch. To help find such programs, the SPA distributes a floppy-disk-based program, SPAudit, that can identify almost 700 of the most popular programs on the market. By running the SPAudit disk on its PCs, a corporation can produce a printout of all the software—legally obtained or otherwise—residing on the machines.

Since it received funding for litigation from 11 of its largest members in 1988, the SPA has initiated 60 lawsuits against corporate abusers, according to Wasch. The SPA has also conducted about 40 audits at companies to determine if employees' PCs hold illegal software.

In the pursuit of eliminating piracy, Wasch says large companies tend to have better procedures in place to prevent illegal copying than smaller businesses. Among the SPA's major allies in the piracy battle are MIS managers who are sensitive to the problem, he says, but notes that these managers must sometimes deal with CEOs and CFOs who are more concerned with saving money than with eliminating copying.

The SPA also gets help from former or current disgruntled corporate employees. As many as 90% of its tips about illegal software copying come from such people, says Wasch.

As part of its anti-piracy program, the SPA encourages companies to post signs warning against copying, to orient employees about the problem, and to conduct regular PC-disk audits. "Perhaps the best thing a company can do, though," says Wasch, "is to allocate enough money for buying software to meet the needs of all its hardware users."

DWIGHT B. DAVIS in Seattle

Japan logs a downturn in electronics spending

*Top companies seem more cautious than in the past.
Still, investments far outpace those by U.S. companies*

BY PAULA DOE

The growth rate of capital spending by Japan's electronics industry has tapered off noticeably. By most accounts growth will continue to slow as Japanese companies adjust to the rising cost of capital, a slowdown in the global semiconductor market, and a dismal economic outlook (at least for much of this year) in the U.S. and many European nations.

Given these conditions and generally sluggish demand in most key electronics markets, the slowdown in capital spending doesn't come as a complete surprise. But many analysts predict that Japanese electronics companies are just beginning to pull back on their capital outlays. Total expenditures by Japan's top 10 electronics companies climbed by about 22% during the fiscal year that ended March 1990, a sharp drop from the 38% increase posted during the previous fiscal year. The top 10 predict they'll average only about 7% investment in Japan during the current fiscal year.

But spending during the current fiscal year is unlikely to rise by more than 10%, according to a *Nihon Keizai Shimbun* survey of large publicly listed electrical and electronics companies. That's optimistic compared to Japan's Economic Planning Agency, which predicts that spending across the sector will climb by as little as 3%. Mitsubishi Electric Corp. actually cut its total capital spending for the year ending March 1990 and expects to trim domestic investment even more during the year ending March 1991.

Those figures contrast sharply with Japanese industry as a whole. Only food, textiles, and paper and pulp show growth as slow or slower. Total spending throughout the nation's manufacturing sector is expected to grow by an average of 16%, but could grow more than twice as much in some industries—shipbuilding could actually increase 39%, for instance—according to Japan's Economic Planning Agency.

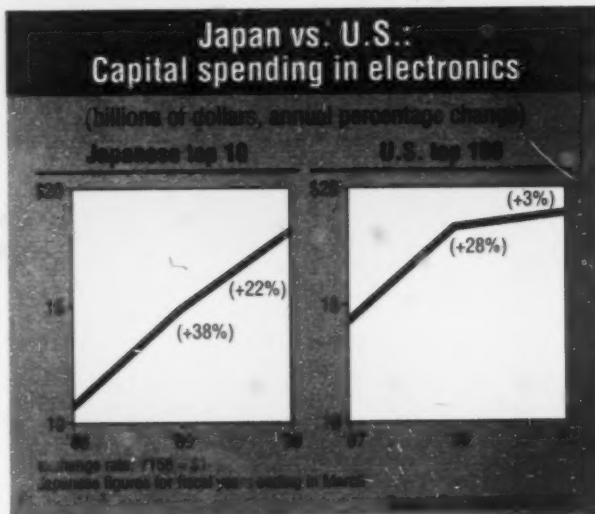
Outside electronics, the overall strategy appears to be to use Japanese companies' huge reserves of cash, accumulated from years of cheap capital and high profits, to build new automated plants for producing higher value-added products while using as little of the nation's costly and scarce labor as possible.

Despite the flattening spending levels by Japanese electronics companies, however, those producers still spend far more than U.S. companies;

while IBM tops the list of capital spenders, in fact, the next seven are all Japanese. Investment in plant and equipment by Japan's 10 largest electronics companies reached a whopping \$18.1 billion during the last fiscal year—nearly as much as the \$18.9 billion spent by the top 100 U.S. companies combined in 1989. Capital spending by those American companies rose by a mere 3% in 1989, despite a 20% drop in the dollar value of Japanese investment caused by the weakening of the yen. The top 10 U.S. companies increased investment only 3.5%.

More important than how much a company spends is how its spending stacks up to that of the competition. Japanese semiconductor makers whose top managements committed to spend more than their competitors have gained market share, provided that middle management spent the money with at least average effectiveness and maintained a sound product strategy and effective production technology, argues Goro Kumagai, analyst at Nomura Securities Co. Ltd. in Tokyo. Those who didn't keep up, lost out.

Among leading Japanese chip makers, Toshiba Corp. and Mitsubishi's semiconductor operations spent more aggressively than their top domestic competitors, according to Nomura Securities. They also appear to have spent more efficiently, increasing their market shares by 2% and 1%, respectively. Hitachi Ltd. not only spent less than average, it got fewer results from each dollar invested; the company's market share



dropped nearly 6 percentage points. NEC Corp. spent the least but it spent it more effectively than most, so it managed to limit its loss of market share to 3%.

Why is Japan cutting back on its spending in the electronics sector? One reason is that there seem to be few compelling reasons to maintain the feverish investment pace of the past. There is far less cutthroat competition among the big Japanese semiconductor companies than there once was, for example, now that these companies so totally dominate some markets and prices are essentially propped up by U.S. government rules.

But another reason may be that producers have reached the limits of what even they can afford, now that capital in Japan is no longer so cheap. Although the investment needed to produce each new generation of memory is expected to approximately double, prices will

remain limited by the low cost of preceding chip generations. Indeed, the cost of keeping up with leading-edge semiconductor production technology has become so high that some companies are wondering how much longer they can remain in

the ever-more-expensive game.

The major Japanese electronics producers don't plan to increase their rate of semiconductor investments at all this year. Those companies plowed an average of 24% of semiconductor revenue back into new semiconductor plant and equipment for the fiscal year ending March 1990, and spent nearly 25% of their total capital budgets on semiconductors. By contrast, capital investment among the 11 U.S. companies on the ELECTRONIC BUSINESS list of top capital spenders that sell primarily semiconductors averages 17% of total revenue.

Changing patterns

One intriguing consequence of these changing investment patterns is that some observers speculate that at least a few of the Japanese companies may decide to withdraw from chip production altogether. □

Spending more to gain global market share

Company	Change in semiconductor market share 1983-1990	Semiconductor investment/semiconductor output 1983-1989	Increase in output per dollar invested 1983-1989
Toshiba	+2.3%	19.6%	.67
Mitsubishi	+1.0%	19.1%	.67
Fujitsu	+0.8%	25.9%	.49
NEC	-3.0%	14.9%	.63
Hitachi	-5.8%	16.9%	.40
Average		18.6%	.57

Notes: All figures are for fiscal years ending in March. Market share figures are based on share of semiconductor production of Japan's top 10 producers. Effectiveness of investment is figured as the increase in value of semiconductor production from March 1984 to March 1991 as a function of capital spending on semiconductors from 1984 through March 1990.

Source: The Nomura Securities Co. Ltd.

Japan's top 10 capital spenders

Growth slows, especially in semiconductors

Rank	Company	Capital expenditures (\$ millions)	Percentage change 1990/1989	Projected change 1991/1990	Capital expenditures as a % of revenue (\$ millions)	Semiconductor/capital expenditures (\$ millions)	Percentage change 1990/1989	Projected change 1991/1990	Semiconductor capital expenditures as a % of semiconductor production
1	Hitachi	\$4,166	24%	1%	9%	\$601	36%	0%	18%
2	Matsushita	2,245	9%	60%	6%	456 ³	38%	1%	28%
3	NEC	2,176	20%	-7%	10%	570	29%	0%	13%
4	Sony	2,049	50%	8%	11%	380	33%	17%	43%
5	Toshiba	2,047	21%	7%	8%	601	6%	0%	14%
6	Fujitsu	1,904	18%	0%	12%	700	126%	-1%	27%
7	Mitsubishi	1,415	-2%	-10%	8%	399 ⁴	37%	5%	19%
8	Sharp	738	45%	8%	9%	285	50%	0%	25%
9	Canon ¹	679	29%	NA	8%	NA	NA	NA	NA
10	Sanyo ²	670	57%	-5%	8%	342	0%	-26%	28%
Total		\$18,089	22%	4%		\$4,334	35%	0%	
Average			27%	7%	9%		39%	0%	24%

All figures for fiscal year ended March 1990 except for:

1. Canon fiscal year ended December 1989

2. Sanyo fiscal year ended November 1989

3. At semiconductor subsidiary Matsushita Denso Kogyo

4. Semiconductor figures for parent company only

NA = not available

U.S. \$ = 158 Yen

Source: Company reports. Projected spending for year ended March 1991 from Nikkei Sangyo Shimbun survey. Semiconductor figures from Nomura Securities Co. Ltd.

Compact gigabyte devices squeeze out larger models

High performance, small size of 5.25-inch drives spur OEMs to replace 8-inch units in new system designs

BY DAVID WEBB

The arrival of volume shipments of high-performance 5.25-inch disk drives with gigabyte capacities signals the beginning of the end for larger form factor drives as a significant product class in the OEM marketplace. Vendors of 5.25-inch drives are overtaking the performance advantages of the larger form factor drives and are aggressively competing with relatively high-margin pricing, low power consumption, and comparable capacities in a much smaller package.

Gigabyte disk-drive market players include Seagate Technology Inc., Micropolis Corp., Maxtor Corp., Hewlett-Packard Co., Fujitsu America Inc., Hitachi America Ltd., and NEC Corp. IBM and Digital Equipment Corp., both big-volume manufacturers of large form factor disks, have had little success penetrating the OEM market beyond their captive consumption. All of these companies are targeting high-end desktop systems, technical workstations, network storage and file servers, minicomputers, and even mainframes and superminis.

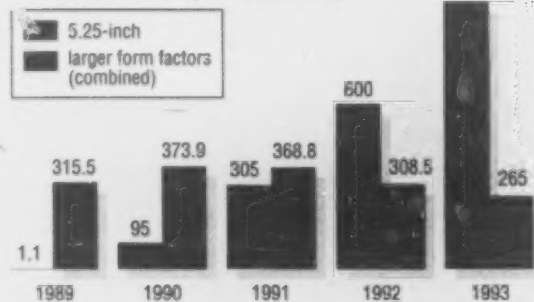
Seagate is the market share leader in the 5.25-inch gigabyte-capacity market thanks to its 1988 acquisition of Control Data Corp.'s Imprimis disk-drive unit; Micropolis commands second place. The rest of the pack is considerably farther behind, with Hewlett-Packard, Hitachi, and Maxtor fighting for third place with small-volume shares.

"The leaders are clearly Seagate and Micropolis," says analyst Crawford Del Prete at International

Data Corp. in Framingham, Mass. "Micropolis is especially aggressive. They have not only announced some impressive products, but they have demonstrated the ability to ship them in volume." IDC estimates 1990 worldwide shipments of gigabyte-capacity 5.25-inch drives at nearly 80,000 units, with Seagate garnering 48%, Micropolis 30%, Hewlett-Packard 14%, and Hitachi 4% of that volume.

The rise of the 5.25-inch drive

Worldwide shipment estimates, gigabyte-capacity drives (units in thousands)



Source: Disk/Trend Inc.

Maxtor, the dominant OEM supplier of 760-megabyte drives, fell behind in the delivery of its Panther series of 1.2-, 1.5-, and 1.7-gigabyte 5.25-inch drives because of manufacturing problems. Ron Lesti, Maxtor's director of new product marketing, says that the product (which was announced in 1989) is now plugged into the company's high-volume manufacturing facility in Singapore and that the company is shipping "thousands" of them.

The world market for disk drives

of all form factors with capacities exceeding 1 gigabyte has grown from \$8.7 billion in 1989 to about \$10.4 billion last year, estimates Disk/Trend Inc., a Mountain View, Calif. storage market research firm. Revenue will hit \$11.6 billion this year, remain flat in 1992, then jump to \$12.4 billion in 1993, according to the company. Total worldwide revenue for all disk drives reached \$25.7 billion in 1990, with gigabyte-capacity drives accounting for more than one-third of the total drive market.

Commercialization of 5.25-inch gigabyte-capacity drives began in 1989; the devices have since become the unit volume leader among all form factors of gigabyte-class drives. Disk/Trend says 1,100 5.25-inch drives were shipped worldwide in 1989, 95,300 were shipped last year, and 305,000 will be shipped this year. Revenue generated from those shipments started at \$2.5 million in 1989, grew to \$938.5 million last year, and is expected to top \$2.5 billion this year. Disk/Trend expects the 5.25-inch gigabyte-capacity market to grow to about \$6.4 billion by 1993.

By comparison, Disk/Trend says 317,000 8-inch and larger disk drives were shipped in 1989, 373,900 were shipped last year, and just under 370,000 are expected to be shipped in 1991, revealing the first overall decline of the class. The firm expects 8-inch shipments by themselves to peak next year with the latest generation of 2.5-gigabyte-capacity products.

"There is at least one more product

MARKET PERSPECTIVES

DISK DRIVES

life cycle left for 8-inch," says Dennis Hill, director of product planning for Fujitsu America Inc.'s Computer Products Group. "[But] it looks as if unit volumes of 8-inch drives are holding level—they aren't growing as we look ahead."

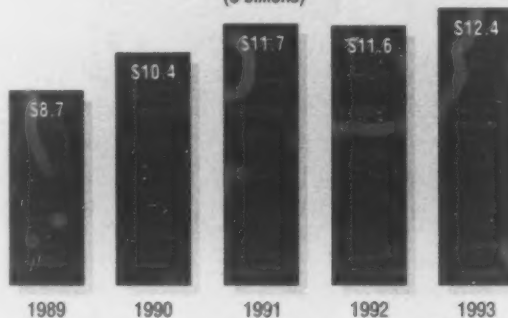
Considered far and away the largest market opportunity for gigabyte-5.25-inch vendors is the so-called 760-megabyte upgrade market, which consists largely of high-end desktop and network server system vendors such as Sun Microsystems Inc., Digital, Hewlett-Packard's Apollo workstation unit, and—at certain times—IBM. Since 1.2-gigabyte-class drives were the first to appear on the market, they have seized the vast majority of this segment, largely because many of these system vendors are targeting applications with insatiable appetites for online storage and have taken what they can get.

"We see tremendous upgrade possibilities in the gigabyte-plus market," says Micropolis's senior vice president Chet Baffa, who thinks a major stumbling block for vendors is user mistrust of 5.25-inch products. "They were not the most reliable things in the world a short time ago, but that has changed."

Rudy Thibodeau, director of marketing at Seagate's Twin Cities, Minn., operations, says the 760-megabyte upgrade market benefits from something older generations of 5.25-inch disk drives didn't—the widespread emergence of the small-computer systems interface (SCSI) among small form factor storage peripherals. Not only are OEMs picking up gigabyte-capacity drives for new system designs, but they have already begun to use them to convert existing systems originally available with 760s. "SCSI makes it easy to pick the next capacity point," according to Thibodeau, explaining that the system integration and design-in process is simplified by SCSI's "intelligent" on-board controller design. SCSI's ease of integration, however, means the OEM system design-in cycles will shrink from what was once 3 years to less than 18 months in most cases.

Larger disk drives face slow growth

Worldwide revenue estimates,
gigabyte-capacity drives
(\$ billions)



Source: Disk/Trend Inc.

An issue that may cloud the 5.25-inch market centers around the viability of demand for 1.6-gigabyte products. Not only have they missed a number of lucrative OEM designs garnered by 1.2-gigabyte vendors, but at least one vendor is shipping 2-gigabyte drives in volume. System vendors wanting to upgrade from 760-class drives to gigabyte-class drives can now choose between 1.2-, 1.6-, and 2-gigabyte capacities, with cost-per-megabyte ratios improving with higher grades of capacity and availability.

Some OEM vendors see the 1.2-gigabyte class as an interim solution in the move from 760-megabyte to 1.6 gigabytes. "From a technical standpoint, 1.6 has suffered some problems resulting from the develop-

ment of new design platforms by other vendors," according to Steve Knab, Hitachi's manager of marketing and business planning in Brisbane, Calif. Hitachi sidestepped those problems by extending its 760-megabyte and 1.2-gigabyte technologies to 1.6 gigabytes, rather than starting from scratch as Maxtor and Seagate did. Micropolis was the only vendor to announce a 2-gigabyte 5.25-inch product by year's end. Others (namely Maxtor, Seagate, Hewlett-Packard, and Fujitsu) are expected to join the market this year.

Confined market

The 8-inch replacement market is largely confined to those segments in which 8-inch is being used in file server, technical workstation, and mini-computer applications—systems in which the performance capabilities of 5.25-inch drives match or nearly match system performance. That market includes the spectrum of form factors, from 8-inch to 9-, 9.5-, 10-, and 14-inch drives.

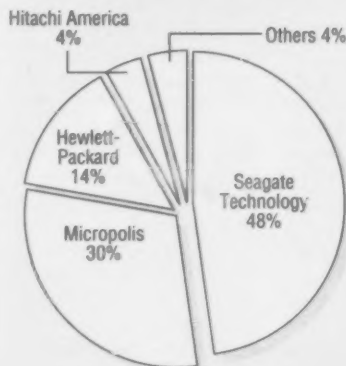
The replacement market for 8-inch and larger disk drives is complicated by technological issues primarily involving drive-to-system interface architectures. The installed base of large drives consists largely of SMD (storage module device)-interface products, which are device-level and non-intelligent; that is, they require a controller that is removed from the drive and resides within the existing system.

The latest version of SCSI, known as SCSI-2, is approaching performance capabilities of SMD, which has been that interface's key attraction for workstation, minicomputer, and mainframe makers who need the fastest disk performance possible. Disk-drive vendors, including those who market both 5.25-inch and large form factor drives, all agree that SCSI developments indicate the architecture will soon reach parity with SMD in performance and eventually beat it.

"By and large, for 5.25 it is a SCSI world," says Micropolis's Baffa, "and it will continue to be, well into the gigabyte capacities." □

The big-drive marketplace

1990 worldwide market share for
5.25-inch gigabyte-capacity drives



Source: IDC

Factory management systems bring planning to the plant floor

Systems that give managers up-to-the-minute control over manufacturing are rapidly gaining acceptance

BY PETER BURROWS

No amount of executive posturing can guarantee that corporate goals such as quality and time-to-market will be met unless those goals are somehow embedded within the manufacturing process itself. "We have all been beaten up with terms like total quality and employee involvement," says consultant Gerry Cahill, a partner with Ernst & Young. "But what managers really need to know is 'how do I enforce those concepts on the shop floor?'"

Vendors of factory management systems say they have the answer, and a growing complement of customers and industry experts agree. These packages let plant supervisors observe and control many elements of the production line in real time, providing a solution to what had

been a conspicuous void in traditional computer-integrated manufacturing, or CIM. Production planners have been aided by MRP (material requirements planning) and the more comprehensive MRP2 (manufacturing resources planning) packages for decades. Equipment operators have had cell-control software. But factory supervisors were largely left to their own devices to manage the complexities of rapidly changing production processes. "You either had a grizzled old veteran who did it on an ad hoc basis, or you didn't do it at all," says Eric Keller, CIM program director with the Gartner Group in Stamford, Conn.

The products in this market still lack uniformity and address varying

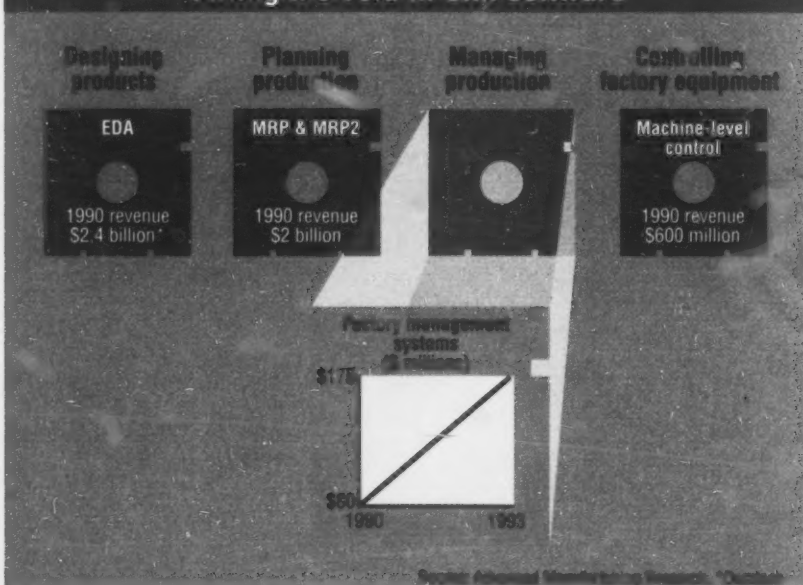
subsets of manufacturing problems. The products even go by several different names, including "shop-floor control systems" and "manufacturing execution systems." But one thing is clear: The market for plantwide factory management software is growing faster than most manufacturing-related businesses. While the market currently stands at only \$75 million, it should grow about 30% a year through 1993, says Bruce Richardson, a vice president with Cambridge, Mass.-based Advanced Manufacturing Research. "It will be one of the few hotspots in CIM in the 1990s," he says. By comparison, Richardson expects the \$2 billion-plus MRP market to grow by only 10-15% per year during the early 1990s.

Electronic companies are leading the way in adopting these technologies, especially "bleeding edge" semiconductor companies that must grab every chance to improve manufacturing processes to compete with foreign competition. "We have improved our yield by whole percentage points," brags Steve Nettles, CAM software manager with Advanced Micro Devices Inc. in Austin. AMD has implemented a system in all of its U.S.-based wafer fabs and sorting facilities and is now extending it to offshore test and assembly plants.

An eye on manufacturing

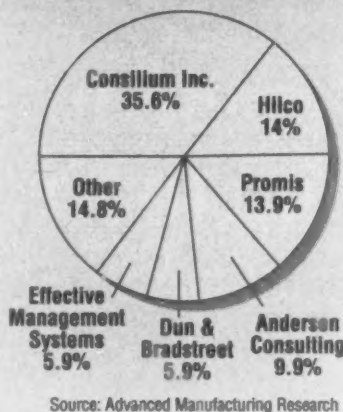
Such success stories are widespread among the core of early adopters, many of whom have been tinkering with homemade factory management programs since the early 1980s. That is because these programs represent the first commercial attempt to automate the minutiae of manufacturing. "MRP systems tell you what you need to do a job, but then they just throw that bucket of materials onto

Filling the void in CIM software



Factory management system software vendors come of age

(Total market = \$101 million)



the shop floor," says Jonathan Golovin, chairman and founder of Consilium Inc. in Mountain View, Calif., the overall market leader. "It just creates a mess for manufacturing supervisors. They don't need to know what the factory will look like in two weeks. They need to know what it will look like in two minutes."

Factory management systems provide that information by tracking work-in-process, equipment and personnel availability, stockroom inventories, and specific customer requirements. Armed with this data, supervisors can more efficiently route materials and allocate resources, giving them the flexibility to alter production plans when last-minute orders, equipment problems, or other hangups occur.

Customers also report quality improvements from the use of factory management systems. Because they are distributed throughout the factory, many of these systems are used as repositories for statistical process control data. Others use them

to ensure that jobs are done correctly by flashing easy-to-follow instructions on monitors at each station.

But the greatest and most challenging virtue of factory management systems is that they force users to take a new look at their jobs. "It makes you consider the entire process rather than just your own part of it," says Boaz Yardeni, CIM systems manager for Talla-Com Industries Inc., a Tal-

lahassee, Fla.-based manufacturer of military radios.

But these systems have many downsides. Implementation often takes more than a year, and the systems are expensive. Although software prices are falling—a new product from Consilium starts at \$30,000, with older packages costing at least twice that—associated hardware and service costs can put the total price for commercial systems in the \$500,000 range. All told, Richardson says that fewer than 2,000 systems have been sold to date.

Such high costs lead to long payback periods, so it isn't easy to justify these systems using traditional cost-accounting methods, says Ed Tomlinson, director of marketing for Toronto-based Promis Systems Corp. "But we find our customers rarely throw our systems out, no matter how old," he says. "You can always make improvements in areas like quality, cost-reduction, or training."

As with many emerging technologies, the greatest obstacles to adoption are cultural. "The biggest problem is get-

All you need to know about 5.25" Semicon disk drives, inside

120MB Full-height 5.25"

SCSI Interface

<.35ms Access time

40MB Half-height 5.25"

Up to 220,000 hours MTBF

4.0M²/Second sustained transfer rate

C&C

Computers and Communications

It's nice to know that NEC disk drives have the most advanced technical features. And it's reassuring that they're consistently available, and with a DOA rate of less than 1%, and up to 220,000 hours MTBF rate that they're reliable.

MARKET PERSPECTIVES

AUTOMATION

ting people to understand what these systems can do for them," says Tallacom's Yardeni. "Most manufacturing people don't consider it their job to report to a computer or look at a screen. You have to find ways to let the system support people rather than hinder them."

Observers say that vendors are on the right track in addressing these problems. Systems integrators such as Andersen Consulting in Chicago, Cimflex Teknowledge in Pittsburgh, and Dun & Bradstreet Software in Atlanta have commercialized technologies they used to sell as custom systems for millions of dollars. Others are moving to modular architectures that enable customers to start slowly and work their way up to comprehensive plantwide systems.

The upshot, vendors say, is that factory management systems are not just for high-volume manufacturers willing to spend millions to realize tiny process improvements. "One of our problems is that people don't realize they can afford this stuff," says

George Pacienza, director of marketing for Cimflex Teknowledge. "That's where the hardware vendors come in."

Indeed, computer companies such as Digital Equipment Corp. in Maynard, Mass., Hewlett-Packard Co. in Palo Alto, Calif., and IBM have identified factory management systems as a good way to boost hardware sales. DEC (which controls about 43% share of the factory floor computing market, according to Advanced Manufacturing Research) has signed six software vendors in its attempt to maintain hold on the production floor. IBM has bought the exclusive rights to a system developed by Incode Corp. of Reston, Va., called POMS (Process Operations Management System) and will begin selling the product under its own label later this year.

As a result, the factory management industry is starting to coalesce into a legitimate industry. Once dominated by financially starved, sub-\$10 million vendors with highly specialized products, some competitors show convincing signs of surviv-

ability. Companies including Consilium, Dun & Bradstreet Software, and Promis have established themselves overseas and forged relationships with the hardware vendors and systems integrators they depend on for survival. And survivability leads to customer confidence, which leads to larger deals. "We are getting fewer simple software package sales and more ambitious projects in the \$2 million to \$3 million range," says Tomlinson.

"I think we are about to see some companies become dominant players," says AMR's Richardson. Favorites include Consilium, which claims 25 of the world's top 50 electronics companies among its clientele, as well as Promis and Dun & Bradstreet Software. With the technology accepted in principle, vendors of factory management systems must now stave off competition from MRP vendors, hardware vendors, and each other. As with the paper-laden manufacturing managers they are trying to serve, Richardson says "the primary danger [for these vendors] is clutter." □

and out.



But all you really need to know is that they're made by NEC, a 24-billion-dollar company, and the fourth largest manufacturer of disk drives in the world. For more information, call 1-800-NEC-INFO.

NEC

Computer makers see meager growth

During 1990, computer and office equipment manufacturers managed to eke out some minor growth as they struggled with weak business investment, shrinking margins, and a shift toward distributed computing. Third-quarter 1990 shipments dropped 1.4% from the year earlier period, but once all the data is tabulated for 1990, we expect shipments to have inched up about 2% for the year to \$71.1 billion.

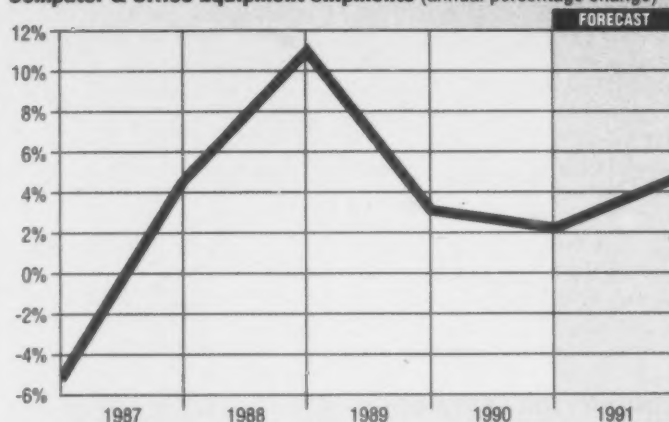
The computer industry can expect one to two more quarters of meager shipments growth before the recovery starts in earnest. Except for a year-over-year decline in August 1990, new orders had been on the upswing and that will feed into increased shipments of 4.5% in 1991. Because bookings began to outrace billings, furthermore, backlogs expanded. This reversed a downward trend in backlogs that started in 1984 and offers the industry a larger safety margin. The turnaround in demand will reflect renewed business investment and healthy increases in exports.

In some respects, computer makers may have stolen some growth away from 1991 by offering steep price concessions in 1990. According to the most recent Datamation/Cowen & Co. Mini/Microcomputer survey, respondents received an average percent-off-list-price of 16.8% for minicomputers, 19.4% for workstations, and 29.7% for mini-super computers.

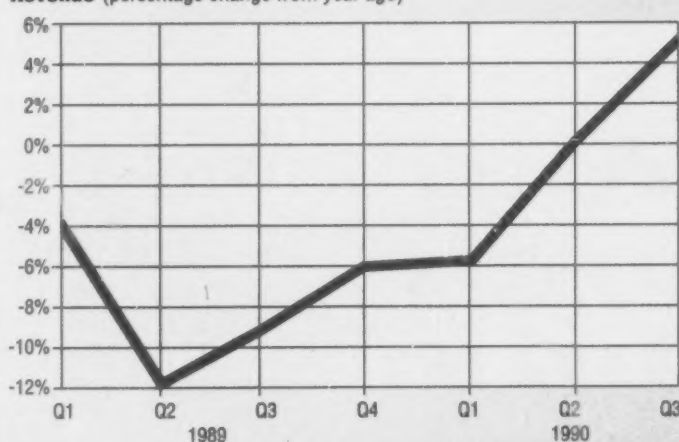
MADELINE FRANCHI

ELECTRONIC BUSINESS indexes

Computer & Office Equipment Shipments (annual percentage change)



Revenue (percentage change from year ago)



Data source: U.S. Commerce Department; Forecasts: Cahners Economics

Computer market database

Latest quarter: 3rd quarter 1990

	Latest quarter	Previous quarter	Change	Year ago	Change	Next year	Change
Industrial production (SA, 1987=100, qtr. total)	153.1	149.6	2.34%	139.4	9.83%	169.9	10.97%
Shipments (SA, \$ millions, qtr. total)	\$ 17,587	\$ 17,837	-1.40%	\$ 17,688	-0.57%	\$ 18,753	6.63%
New orders (SA, \$ millions, qtr. total)	\$ 18,520	\$ 17,598	5.24%	\$ 17,959	3.12%	\$ 19,197	3.66%
Unfilled orders (SA, \$ millions, qtr. total)	\$ 13,147	\$ 12,214	7.64%	\$ 12,477	5.37%	\$ 13,383	1.80%
Inventory-to-shipments (SA, end of qtr.)	2.06	1.96	—	2.07	—	2.07	—
All employees (thousands, end of qtr.)	441.0	447.4	-1.43%	460.2	-4.17%	428.1	-2.93%
Production workers (thousands, end of qtr.)	139.0	141.4	-1.70%	146.5	-5.12%	136.4	-1.87%
Business purchases (SAAR, \$ billions, qtr. total)	\$ 39.64	\$ 40.28	-1.59%	\$ 41.16	-3.69%	\$ 41.34	4.29%
Business purchases (SAAR, 1982 \$ billions)	\$ 124.27	\$ 125.11	-0.67%	\$ 119.62	3.89%	\$ 136.40	9.76%

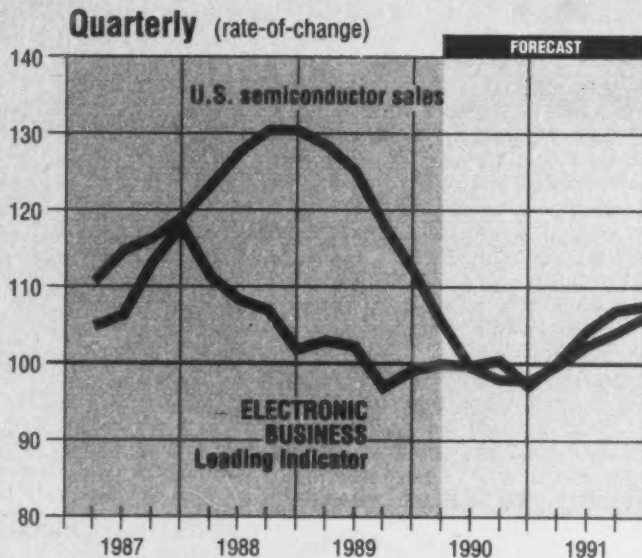
SA = seasonally adjusted; SAAR = seasonally adjusted annualized rate; all other data is not seasonally adjusted

Data sources: Federal Reserve Board, U.S. Bureau of the Census and U.S. Bureau of Labor Statistics
All data for SIC 357, except industrial production, SIC 357-9. Forecasts: Cahners Economics

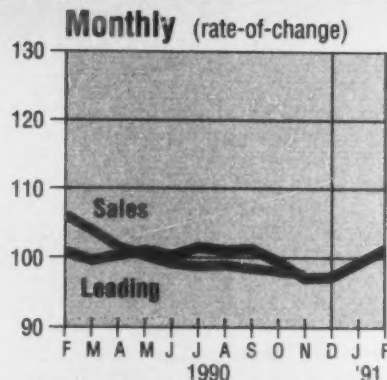
BUSINESS BAROMETER

FORECASTS FOR ELECTRONICS, COMPUTERS, AND SYSTEMS

ELECTRONIC BUSINESS Leading Indicator



To obtain your complimentary copy of a 12-page background paper on the ELECTRONIC BUSINESS Leading Indicator, please contact Linda Spiller at Cahners Publishing Company, 275 Washington St., Newton, MA 02158-1630, USA; telephone (617) 558-4397; fax (617) 558-4402.



The ELECTRONIC BUSINESS Leading Indicator again refused to show an upturn with the latest data. In November, the EBLI fell 2.4 points to 96.9 from 99.3 in October. Whereas the main contributor to the stagnant EBLI in the prior three months was the sinking semiconductor stock price index, recent data revealed declines for four of the six EBLI components. The two exceptions were contracts and orders for plant and equipment, and the stock price index which, after a four month dive, climbed 2.9 points in November. The evidence of a slowdown is more convincing and has led to a revised forecast with a peak of 108.6 pushed to October 1991.

Source: Cahners Economics

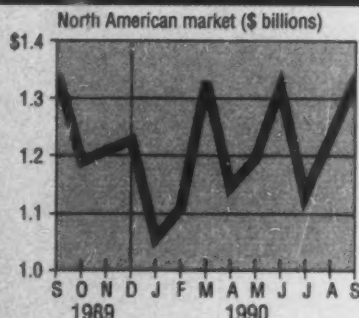
Electronics industry indicators this month

	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS Leading Indicator (rate-of-change, Nov.)	96.85	199.28	99.71	100.9
U.S. semiconductor bookings (\$ millions, 3-month average, Nov.)	\$1,165	\$1,198	\$1,135	\$1,205
Weekly hours of semiconductor production workers (monthly average, Oct.)	40.0	40.7	40.8	40.1
Electronics components lead time index (1977 = 100, Dec.)	67.2	80.5	89.9	102.5
S&P's semiconductor stock price index (1970 = 10, monthly average, Dec.)	54.9	52.0	57.1	54.7
Change in electronics-components inventories (\$ millions, SA, Nov.)	-\$6	\$47	-\$48	-\$12.8
Contracts and orders for plant and equipment (\$ billions, SA, Oct.)	\$45.2	\$42.1	\$41.8	\$43.4

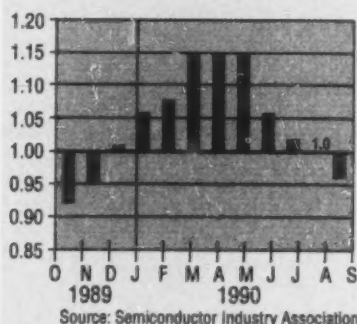
SA = seasonally adjusted, all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, Electronics Purchasing magazine, Standard & Poor's, U.S. Department of Commerce, U.S. Bureau of Economic Analysis

Semiconductor sales



Semiconductor book-to-bill ratio



Component inventory-to-shipments

